CHAPTER 5

NUCLEAR, BIOLOGICAL, AND CHEMICAL OPERATIONS

5-1. **The following tasks are referenced in Appendix E:**

031-503-1004/ 031-503-1025	Put on, wear, remove, and store your M17/M40 series protective mask with hood.
031-503-1005/ 031-503-1026	Maintain your M17/M40-series protective mask with hood.
031-503-1007	Decontaminate your skin and personal equipment.
031-503-1015	Put on and wear MOPP gear.
031-503-1019	Recognize and react to chemical or biological hazard.
031-503-1018	React to nuclear hazard.
031-503-1014	Use M8 detector paper to identify chemical agent.
031-503-1020	Use M9 detector paper to detect chemical agent.
031-503-1023	Exchange MOPP gear.
031-503-1030	Prepare the chemical agent monitor for operator.
031-503-1031	Put the chemical agent monitor into operation.
31-503-1006	Drink from canteen while wearing your protective mask.
031-503-1008	Use the latrine while wearing MOPP 4.
031-503-1024	Replace canister on your M40-Series protective mask.
031-503-1025	Put on, wear, remove, and store your M40-Series protective mask.

5-2. **Decontamination Equipment**

When skin becomes contaminated, decontaminate it immediately that is, neutralize or remove contamination from all exposed skin. Do this by using the M258AI skin decon kit (Figure 5-1) or M291 skin decon kit (Figure 5-2), which are issued to each soldier. If a soldier is incapacitated, a buddy must perform the decon, using the kit issued to the victim

a. The M258AI skin decon kit is designed for chemical decon. It comes in a hard plastic case containing three sets of foil-packaged decontaminating wipes. These wipes contain solutions that neutralize most nerve and blister agents. Attach the kit to the protective mask carrier or LCE. Protect it from temperatures above 110F (43'C) and below 32F (0C). The substances in the packets leave a residue on the mask that when checked with M8 paper causes a color change similar to GB. The Soldiers Manual of Common task provides a step-by-step procedures on the use of the kit. For details on the maintenance and care of the kit see TM 3-4240-216-10.

NOTE

The M258A1 decontamination kit (olive drab case and wipe packets) will only be used for actual chemical decontamination. For training and evaluation purposes, use the M58A1 training aid decontamination kit (black case and blue wipe packets). Do not use wipes on eyes, mouth, or open wounds. These areas should be flushed with water.

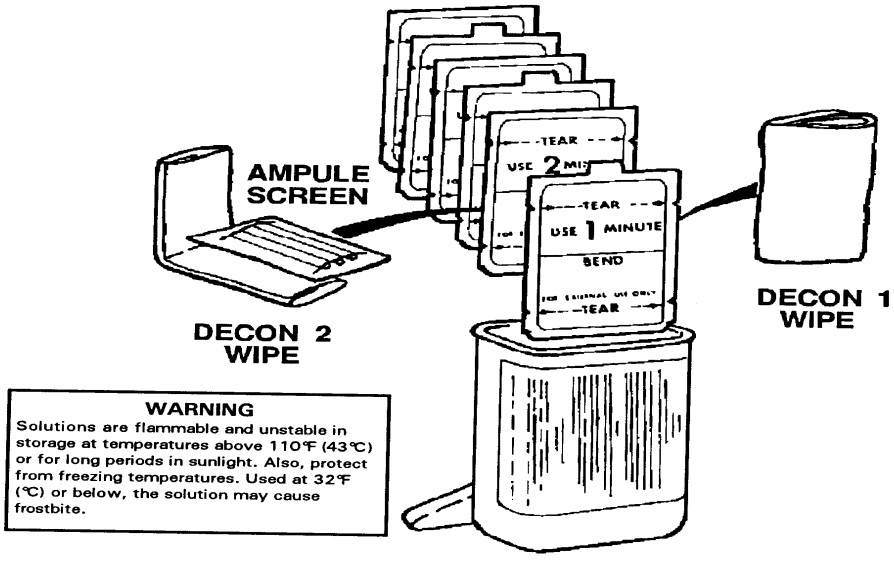

Figure 5-1. The M258A1 Kit

The M291 skin decon kit, (Figure 5-2) as it becomes available replaces the M258Al for skin decontamination. It consists of a flexible outer pouch containing decontaminating packets. Each packet consists of a foil-packaged, laminated fiber material containing a reactive resin. Its use is very similar to that of the M258AI. It decontaminates the soldier's hands, face ears and neck. The M291 kit should be stored in the large cargo pockets of the BDO trouser for easy access. The M291 is capable of operation in temperatures ranging from –50'F to 120'F.

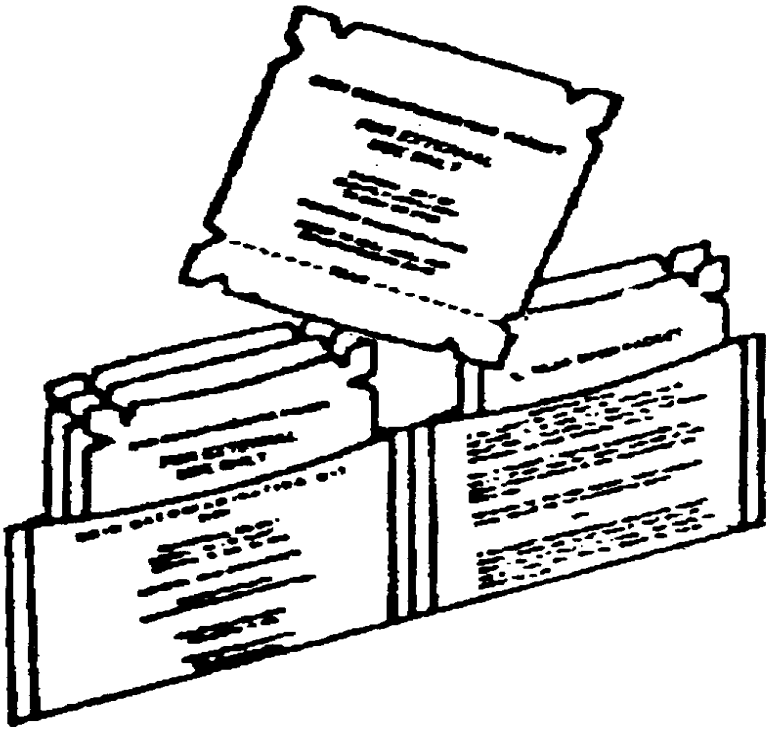

Figure 5-2. M291 Kit

c. Use the M13 apparatus to decontaminate vehicles and crew-served weapons larger than .50 caliber. The M13 (Figure 5-3) is about the size of a 5-gallon gasoline can. It comes prefilled with 14 liters of DS2 decon agent. Decon capability is 1,200 square feet. A hose assembly, pump assembly, wand assembly, and brush are attached to the fluid container for disseminating DS2. The brush allows removal of thickened agents, mud, grease, or other material from surfaces. See TM 3-4230-214-12&P for further information.

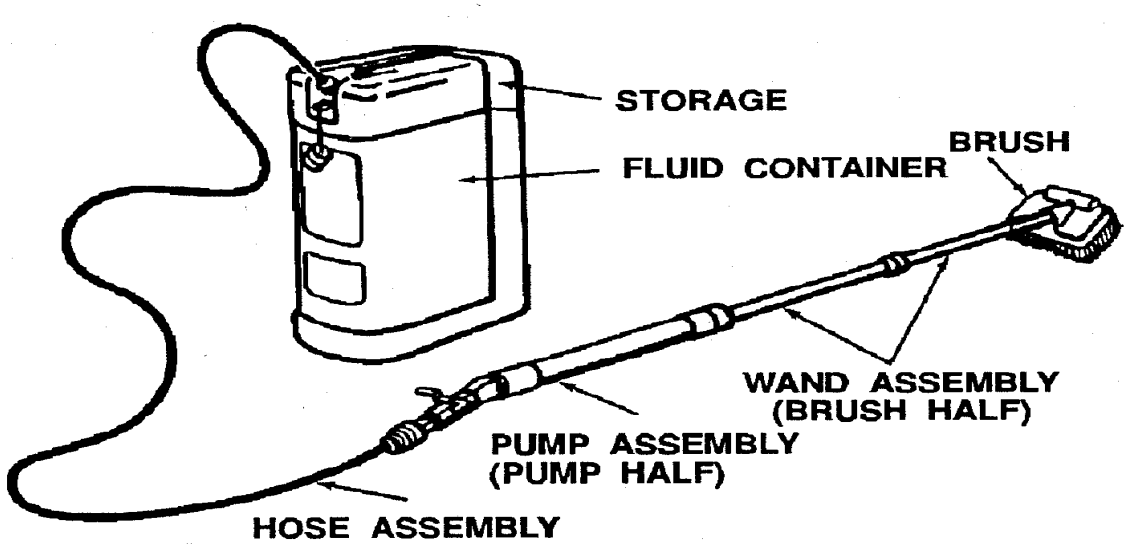

Figure 5-3. M-13 Portable Decontaminating Apparatus

d. The Ml1 apparatus (Figure 5-4) decontaminates small areas, such as the steering wheel or other equipment that soldiers must touch. It is a steel container with aluminum spray-head assembly and a nitrogen gas cylinder that provides the pressure. It is filled with 1-1/3 quarts of DS2, which is sufficient for covering 135 square feet. The effective spray range is 6 to 8 feet. After each use, refill the Ml1 with DS2 and fit it with a new nitrogen cylinder, and it will be ready to use again. See TM 3-4230-204-12&P for additional information.

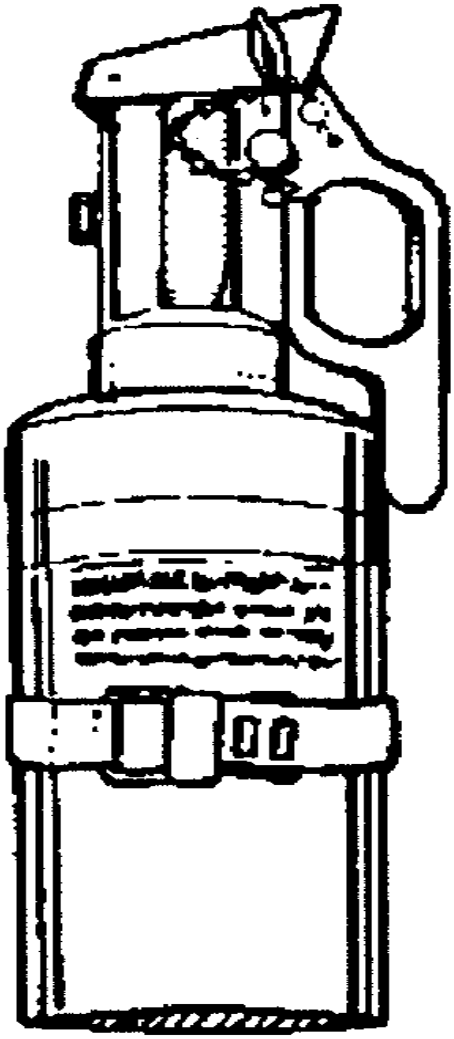

Figure 5-4 ABC-M11 Portable Decontaminating Apparatus

5-3. **Detection Equipment**

On the battlefield, soldiers need to help measure radiation and detect chemical agents. They may use radiacmeters (dosimeters) to record cumulative gamma and neutron radiation dosages received and detector papers to detect and identify liquid chemical agents.

a. The new DT236/PD individual dosimeter looks like a wristwatch without a face. Wear it on the wrist to measure the cumulative dose of gamma and neutron radiation received. It is designed to augment the IM93 dosimeter. Selected trained personnel use the CP696/UD radiac computer-indicator to read this dosimeter (Figure 5-5). Data obtained form the basis of radiation dose exposure records. Units will maintain one DT236 per individual assigned plus 10 percent for loss or damage. During periods of heightened

tension when other contingency items are issued to soldiers, the DT236/PD will be issued to each individual. Once issued, each soldier will wear the DT236/PD on his wrist at all times except when being read and cleaned. The readings obtained from DT236/PD dosimeters in a unit will be averaged and used to determine the radiation exposure status (RES). The RES determined from existing dosimetery equipment and the RES based on the DT236/PD will be compared and the higher of the category (worst case) will be used. When the unit assumes MOPP, the DT236/PD will be worn underneath the MOPP suit. A DT236 may be decontaminated with the M258AI and the M291 skin decon kits.
However, if a chemical agent soaks into the wristband, it must be replaced. The DT236 is not designed to replace existing dosimetry equipment and specifically is not designed to replace the film badge worn by medical personnel. The DT236 is designed to be worn by tactical personnel only. TM 11-6665-236-12 gives instructions on the care and maintenance of the DT236/PD.

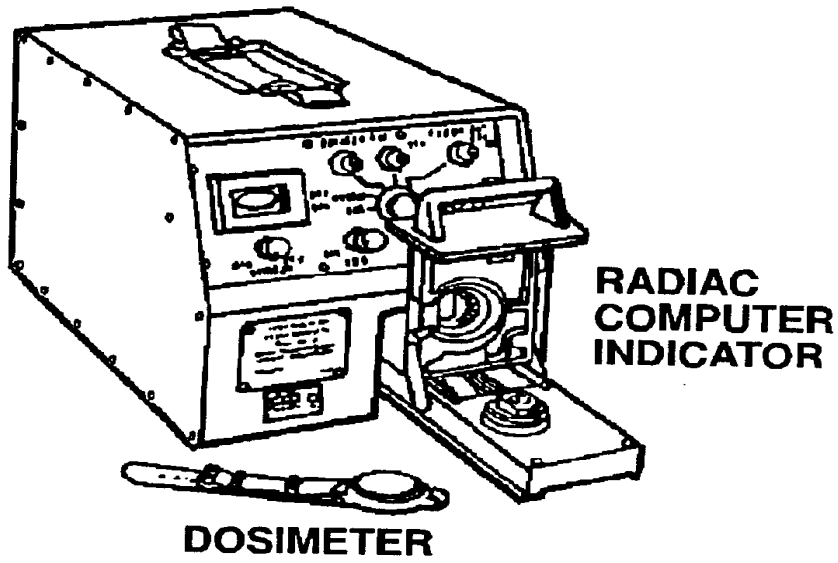

Figure 5-5. CP696/UD Radiac Computer Indicator and the DT236/PD Dosimeter

b. Soldiers receive two types of chemical agent detector paper. The ABC-M8 VGH chemical agent detector paper is called M8. It detects and identifies liquid agents. The M9 does not identify agents. M8 detector paper (Figure 5-6) comes in booklets of 25 sheets. Use the M8 paper to detect and identify liquid V-or G-type nerve agents or H-type blister agents. The sheets are impregnated with chemical compounds that turn dark green, yellow, or red upon contact with a liquid chemical agent. A color chart in the booklet helps determine type of agent contacted. The paper must touch liquid agent; it does not detect vapor. It is best suited for use on nonporous materials. Because some solvents

also cause it to change color, the paper is unreliable for determining the completeness of decon: for example DS2 mimics a positive V agent reaction, a black/green color (see FM 3-5). The M8 paper is also in the M256/M256Al chemical agent detector kit.

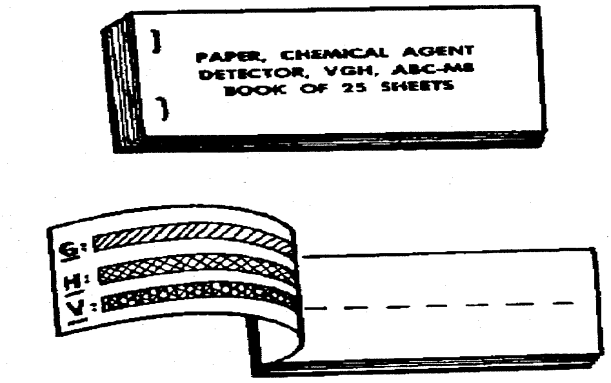

Figure 5-6. M8 Paper

c. Use M9 chemical agent detector paper (Figure 5-7) to detect the presence of liquid chemical agents. It does not detect chemical agent vapor. The paper indicates the presence of a nerve agent (G and V) or a blister agent (H and L) by turning a red or reddish color. Because of this, read M9 paper with only a white-light source. The self-adhesive M9 paper attaches to most surfaces. When attaching it to clothing, place it on the upper portion of your right arm, left wrist, and either your left or right ankle to allow adequate representation of contamination encountered. When placing it on a piece of equipment, ensure the location is free of dirt, oil, and grease, and place the paper where it will not be stepped on. It is advised that M9 paper that has been placed on equipment be removed before DS2 is sprayed over it; if that is not done, it becomes almost impossible to remove the paper. The M9 paper is usable in any weather, in temperatures above 32F (0C). However, exposure to extremely high temperatures may produce false readings. Scuffs, certain types of organic liquids, and DS2 also cause false readings. DS2 turns M9 paper blue. If the paper shows spots or streaks of pink, red-brown, red-purple, or any shade of red, assume it has been exposed to a chemical agent. See TM 3-6665-311-10 for further information.

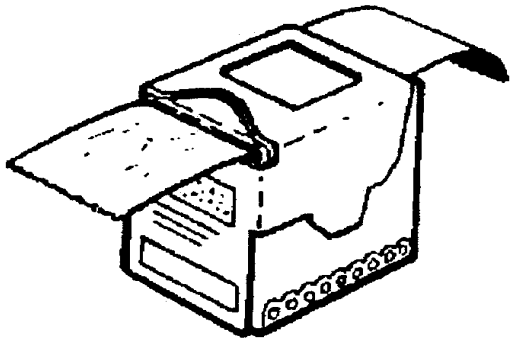

Figure 5-7. M9 Paper

d. The M256-series chemical agent detector kit (Figure 5-8) is issued at squad, crew, or section level. It provides a squad-level ability to detect and identify field concentrations of nerve blister, or blood agent vapors. It differentiates between classes of agents and helps determine when unmasking may be safe after a chemical attack. The kit consists of 12 individually packaged samplers/detectors, a set of instruction cards, and a packet of ABC-M8 VGH chemical agent detector paper. These components come packed in a small, compact, plastic case. Each sampler/detector detects harmful vapor concentrations of nerve, blister, and blood agents. It changes color upon contact with chemical agents at concentrations hazardous to an unmasked person. See TM 3-6665-307-10 for further information.

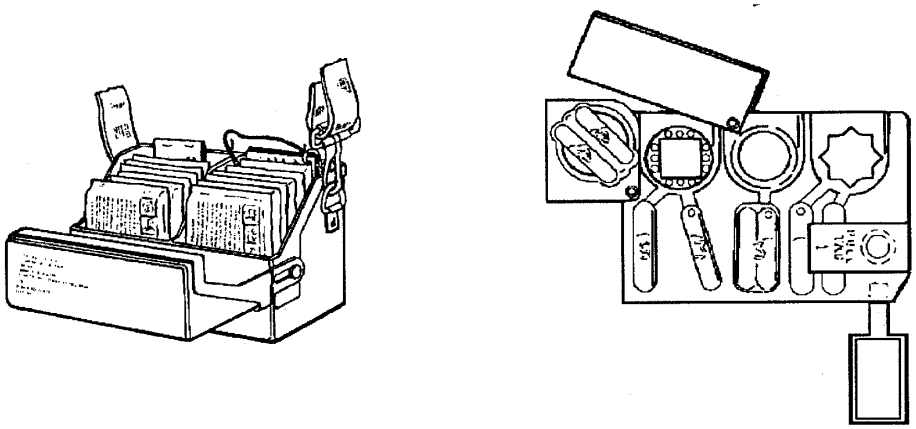

Figure 5-8. M256 Chemical Agent Detector Kit

NOTE

The following tasks are referenced in STP 21-24, SMCT, dated October 1994: 031-503-2001 Use M256 or M256AI Chemical Agent Detector kit and 031-503-2013 Use and Perform Operator Maintenance on the IM174-Series Radiacmeter.

a. Use M256 or M256AI Chemical Agent Detector kit.

(1) Use M256 or M256A1 Chemical Agent Detector Kit

(a) CONDITIONS

Given a chemically contaminated area, an M256 or M256A1 chemical agent detector kit, and a watch. You are in MOPP4.

(b) STANDARDS

1 Perform operator checks on M256 or M256AI.

2 Operate the 14256 or M256A1 in sequence.

3 Identify agent found.

4 Report results to supervisor.

(c) TRAINING AND EVALUATION

NOTE

Use the M256 TRAINING kit for all training and evaluation purposes. Notify supervisor if discard date is within six months, so a new kit can be ordered. Dispose of damaged sampler-detectors IAW TM 3-6665-307-10.

1 Before operator preventive maintenance checks and services (PMCS):

a Check waist and shoulder straps to ensure they are not broken.

b Check that M8 paper is present.

c Check each sampler-detector protective bag for discard date.

d Ensure at least four sampler-detectors are in the kit.

2 Preparation for use.

a Put the shoulder strap over your head and one shoulder. Adjust the shoulder strap so that kit hangs at your waist.

b Hook the waist belt attachment strap to your belt.

c Open the kit by pulling the strap away from the fastener strip. Grasp case top and pull up while turning top away from your body.

d Take out the instruction cards and read both sides of the three or four cards.

e Take out one sampler-detector and read both sides of the protective bag.

WARNING

To avoid test results you cannot trust, open sampler-detector bag and conduct tests while facing into the wind. This will prevent vapors from your equipment and clothing from contaminating the sampler-detector.

NOTE

Do not let sampler-detector be exposed to heavy rain or other forms of water. You may not be able to trust the test results. Do not touch sampler-detector test spots. Dirt and oil from your gloves will cause results you cannot trust.

f Open the sampler-detector by tearing the protective bag along tear line marked by arrows. Carefully pull out sampler-detector and save bag for reference to instructions.

g Examine sampler-detector for broken or missing ampules, missing spots, or crushed reagent channels.

h Check blood agent test spot (pinkish, discard).

3 Testing for toxic agent vapors.

WARNING

Before breaking glass ampules (except heater ampules), place one heater pad on each side of the sampler-detector, covering the ampule to be broken. These pads will prevent pieces of glass from cutting your gloves or hands.

a Swing out the heater; remove and save the two heater pads for breaking glass ampules. Keep protective strips over spots. Swing heater back in.

b Remove pull tab (marked 1) to expose Lewisite detecting tablet.

c Bend tab (marked 2) over Lewisite detecting tablet and rub upper half of tab until a mark is visible.

d Hold sampler-detector with test spots and arrow pointing up.

e Using the heater pads, crush four ampules in the three center pockets (marked 3).

NOTE

The nerve spot test area may be difficult to wet with solutions as kit gets older. Work solutions into spot carefully, while pressing protective strip over nerve agent spot.

f Turn sampler-detector with test spots and arrow pointing down. Using heater pads, squeeze ampules to force liquid through formed channels.

g Hold the sampler-detector with test spots and arrow pointing down and your thumb on the protective strip over the middle test spot.

h Swing the heater away from the test spot.

i Activate first heater ampule (marked 4) by crushing one green ampule, and swing heater immediately over test spot. Hold sampler-detector to one side, while venting to avoid vapor. Do not use heater pads to crush this ampule.

j After about two minutes, swing heater away from test spot, and protective strip away from test spots.

WARNING

Do not hold sampler-detector in direct sunlight while exposing test spots. You may not be able to trust the test results.

k Expose the test spots for ten minutes. The sampler-detector can be laid down or held by hinged protective strip.

l After about ten minutes have elapsed, crush the second green ampule (marked 4) and swing heater immediately over test spot.

m After about one minute, swing heater away from test spot.

n Hold sampler-detector with test spots and arrow pointing down.

o Using heater pads, crush remaining ampules (marked 5). Be sure to wet test spots by squeezing ampules to force liquid onto test spots.

p Re-rub Lewisite detecting tablet. Bend tab over Lewisite detecting tablet and rub bottom half of tab until a mark is visible.

q Turn the sampler-detector upside down and compare colors of test spots with those shown on sampler-detector. Look for a change in color of rub marks on Lewisite detecting tab.
If your kit has a fourth instruction card, use it to compare colors to determine safe or dangerous condition.

r Report the test results to your supervisor.

NOTE

You can compare blood agent (round spot) and Lewisite (rubbing tab) tests after about ten minutes exposure time. Blister agents (H and CX) develop color immediately after all ampules are broken. Nerve agent requires a waiting period of about three minutes. If no color develops for the M256A1, a positive nerve test is indicated.Disregard any small blue or blue-green areas under plastic rim of nerve agent spot. Look very closely at rub marks on Lewisite tablet rubbing tab. At low concentrations, change may be very slight. Compare with second rub mark before making judgement.

NOTE

Yellow and orange sometimes occur on blood agent spot when no agent is present. Pink or blue must be present to indicate blood agents. Any combination of colors, or rainbow effect, which includes pink or blue should be considered as a positive blood agent test.

4 After operation PMCS.

a Check that M8 paper is present.

b Make sure there are at least four sampler-detectors in the kit.

b. The chemical agent monitor (CAM) (Figure 5-9) is designed to be used to detect chemical agent vapor and provide a readout of the relative concentration of vapor present. It can be employed to monitor-

*Personnel or vehicles prior to decontamination and after.
*The inside of collective protection shelters.
*Relative concentrations of agents to assist in the selection of the appropriate level of protective posture.
*The completeness of decontamination.

The CAM draws in air and samples it for contamination. It indicates the level of contamination on a bar graph indicator. When very light concentrations are present, the CAM samples for a longer period of time to reduce the possibility of false indications. When an agent vapor is detected, the CAM will provide a bar graph indication of the relative concentration of the sample (Figure 5-10). Although very close to what is actually there, the indication is only an approximation of the concentration. If vapor is not present, the instrument will not provide an indication. If vapors were transient, the CAM would provide intermittent indications. This is primarily a function of weather, time of exposure, and the challenge presented. See TM 3-6665-327-13&P for instructions on care and maintenance.

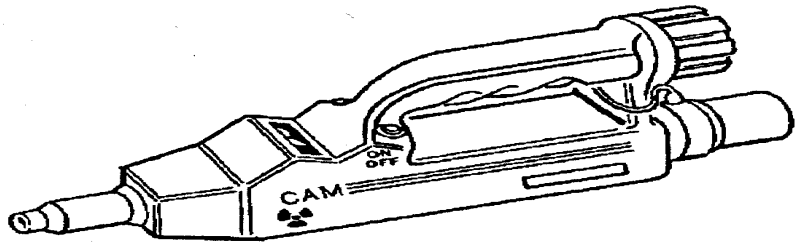

Figure 5-9. Chemical Agent Monitor

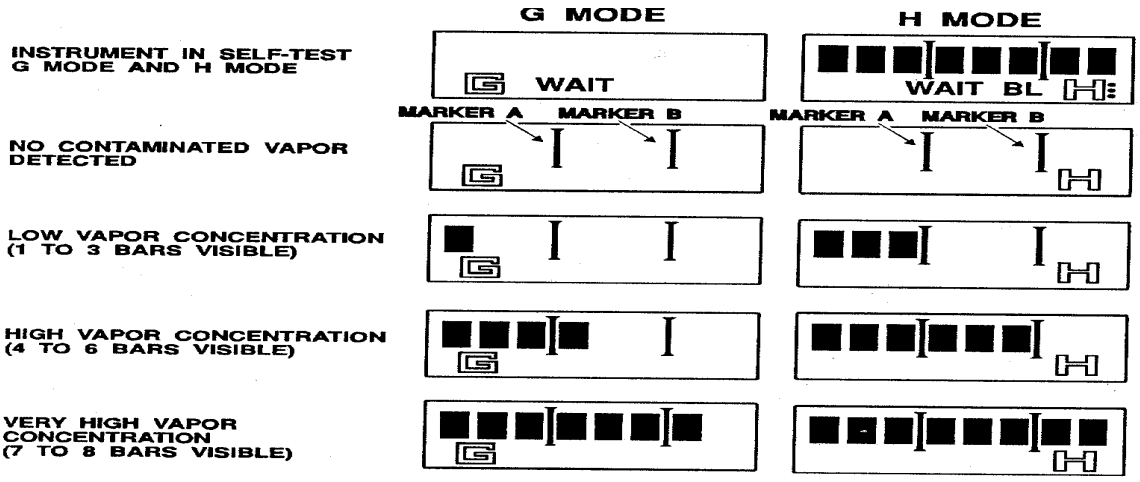

Figure 5-10. Cam Displays

c. The Army standard tactical instrument for reading total radiation dose is the IM93/UD (Figure 5-11). It is a tubular device, about the size of a fountain pen. It allows the user to read the accumulated gamma total dose simply by looking through the lens while pointing the instrument toward the sun or another bright light source. One end has a dust cap to keep dirt from the charging contacts. This dosimeter requires a charging unit-the PPI578A/PD radiac-detector charger. This charger is a small, electrostatic-charge generator. It is designed to serve all US and certain NATO combat dosimeters. The charger has its own NATO adapter stored within the case. The major operating features of the charger are the charging knob, charging pedestal, and window. Reading the unit requires direct sunlight or another bright light source, such as vehicle headlights or a flashlight. See TM 11-6665-214-10 for instructions on care and maintenance.

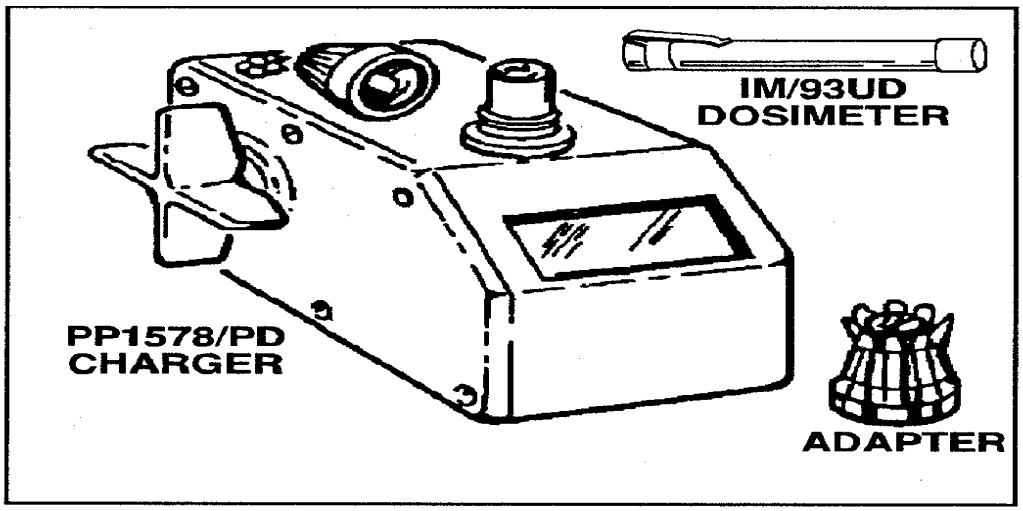

Figure 5-11 The PP1578A/PD Radiac detector charger-IM 93/UD Dosimeter-/Adapter.

d. The M272 (Figure 5-12) kit will detect and identify dangerous levels of common chemical warfare (CW) agents in water sources. Non-chemical corps personnel who are required to collect and check any water source such as wells, lakes, rivers, and city water systems can use it. The M272 is a lightweight kit that will detect and identify harmful amounts of CW agents when those are present in raw or treated water. See TM 3-6665-319-10 for further information.

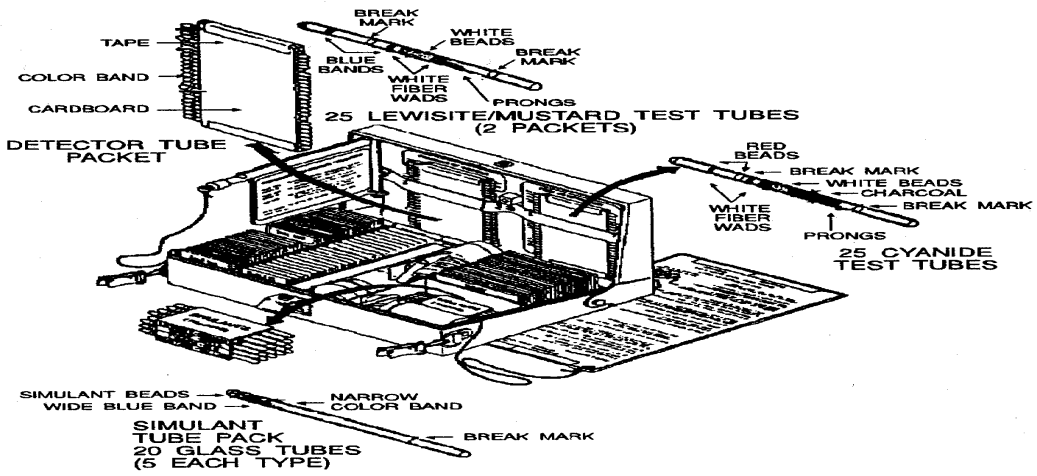

Figure 5-12 M272 Water Testing Kit.

e. The AN/VDR2 is used to locate and measure radioactivity in the form of gamma rays and beta particles (Figure 5-13). It displays dose rates and total accumulated dose resulting from fallout. The AN/VDR2 has the following:

*it detects, measures, and displays level of gamma radiation dose rate from 0.01 ucyph to 100 Gyph.
*it detects and displays level of beta particle dose rate from 0.01 uGy to 5 cgyph.
*it measures, stores, and displays accumulated dose from 0.01 uGy to 9.99 Gy.

The AN/VDR2 will replace the IM174/PD and the AN/PDR27 as the standard radiac instrument. See TM 11-6665-251-10 for further information capabilities.

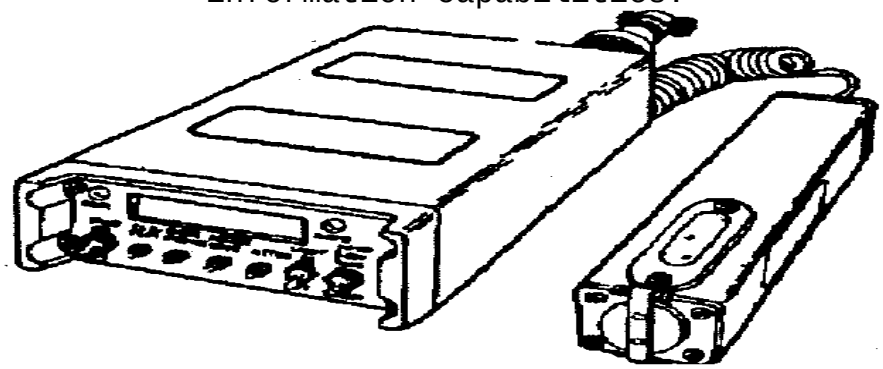

Figure 5-13. AN/VDR2 Radiac Set

f. The IM174 series (Figure 5-14) is a portable tactical survey instrument designed to measure gamma radiation dose rates from 0 to 500 cgyph. NBC personnel to determine gamma radiation levels from radioactive contaminants while performing survey and monitoring tasks primarily use the IM174 series. Procedures for using the IM174/PD are discussed in FM 3-3. TM 11-6665-213-12 provides further information.

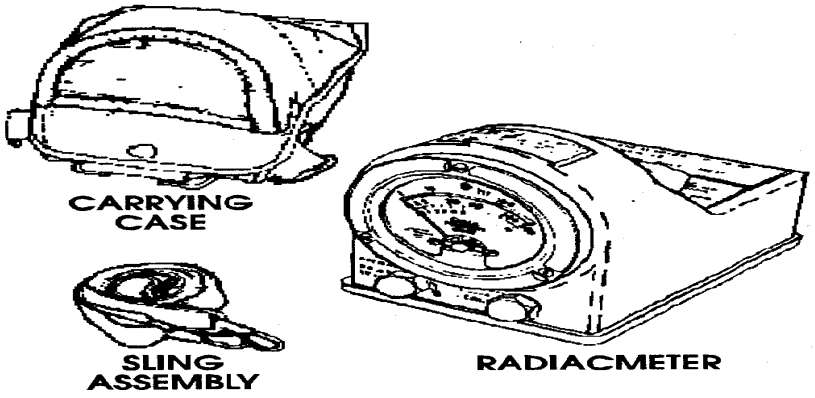

Figure 5-14. 174/PD Radiacmeter

(2) USE AND PERFORM OPERATOR MAINTENANCE ON THE IM174-SERIES RADIACMETER Task# 031-503-2013

(a) CONDITIONS

Given an IM174-series radiacmeter; TM 11-6665-213-12 or TM 11-6665-232-12; appropriate batteries; clean, lint-free cloth; a soft brush; fine sandpaper or *No.* 000 steel wool; a flat-tip screwdriver (or similar object); denatured alcohol; pencil; and paper.

(b) STANDARDS

Perform preventive maintenance checks and services (PMCS) on IM174-series radiacmeter and prepare the radiacmeter for use. Read instrument within plus or minus 10 percent.

(c) TRAINING AND EVALUATION

1 The IM174-series radiacmeter is a radiation detection instrument that measures gamma radiation. It has a dose rate range of 1 to 500 centigray (cGy) per hour.

2 The IM174A/PD radiacmeter can have a radioactive meter dial or a nonradioactive meter dial or a nonradioactive meter dial with a meter light. The IM174A/PD can be single-battery or multi-battery type.

3 The IMl74B/PD comes only as a single-battery type and has a built-in meter light.

4 Operator PMCS is required before and after operation.

a Before operation PMCS includes the following actions:

[1] Ensure the DA Label 80 is affixed to the instrument and indicates the instrument is within the calibration/certification requirements.

[2] Clean exterior metal surfaces with denatured alcohol, cleaning cloth, and brush. Remove rust and corrosion from battery contacts with sandpaper or steel wool.

[3] Inspect for cracked or broken meter glass. Clean, using soft cloth.

[4] Check controls for smooth operation (no sticking or binding).

WARNING

Provide adequate ventilation when using denatured alcohol. Do not use near heat or open flame.

[5] Inspect meter lamp battery and clip ring (if present) for corrosion or damage. Clean meter lamp if necessary.

[6] Inspect battery compartment and contacts for corrosion and damage. Sand off rust and corrosion. Wipe clean with alcohol dampened cloth.

[7] Check batteries for signs of leakage or corrosion. Dispose of leaking batteries through supply channels.

[8] Check for sticking or bent pointer once batteries are installed.

b After operation, PMCS consists of removing the battery or batteries.

[1] Remove battery cover by loosening captive screw(s) and lifting cover with flat-tip screwdriver.

[2] Remove battery or batteries and replace cover.

NOTE

Uncorrected deficiencies or shortcomings must be recorded on DA Form 2404 IAW DA Pam 738-750. However, this is not a performance measure of this task.

5 Batteries should be installed when preparing the radiacmeter for use. Meter lamp battery is installed following the same procedures.

a Loosen captive screw(s) and remove battery cover.

b Install batteries following the polarity marks on the battery compartment.

c Remove the meter lamp cover (not waterproof) by lifting the tab on the bottom. The cover snaps back into place.

6 The radiacmeter should be prepared for use.

a Unfasten snaps on carrying case, pull back, and snap to rear fastener.

b Turn OFF/SET knob clockwise to SET. Allow at least two minutes for warm-up. Twenty minutes should be allowed for complete warm-up.

c Zero the instrument.

[1] Hold ZERO/CHECK switch at zero.

[2] Adjust OFF/SET knob until needle is aligned on zero.

[3] Release ZERO/CHECK switch. Needle should move to between five and ten centigray (cGy) per hour and return to zero.

NOTE

This instrument can be zeroed in a contaminated area.

d Perform battery check.

[1] Hold ZERO/CHECK switch at CHECK.

[2] Needle should move to and stay in

CHECK band. Reading must be within band or no more than three needle widths above. If low, replace batteries.

[3] Release switch.

g. The AN/PDR27 (Figure 5-15) is designed to detect beta radiation and measure and detect gamma radiation. The AN/PDR27 is used as a point source instrument to monitor low levels of radiation contamination on personnel, supplies, and equipment. It is portable, watertight, lightweight, and rugged. It is issued on a one per divisional company-size combat and combat support unit and as required for medical, maintenance, and bath units and water supply points. See TM 11-6665-209-15 and TM 11-6665-230-15 for further information.

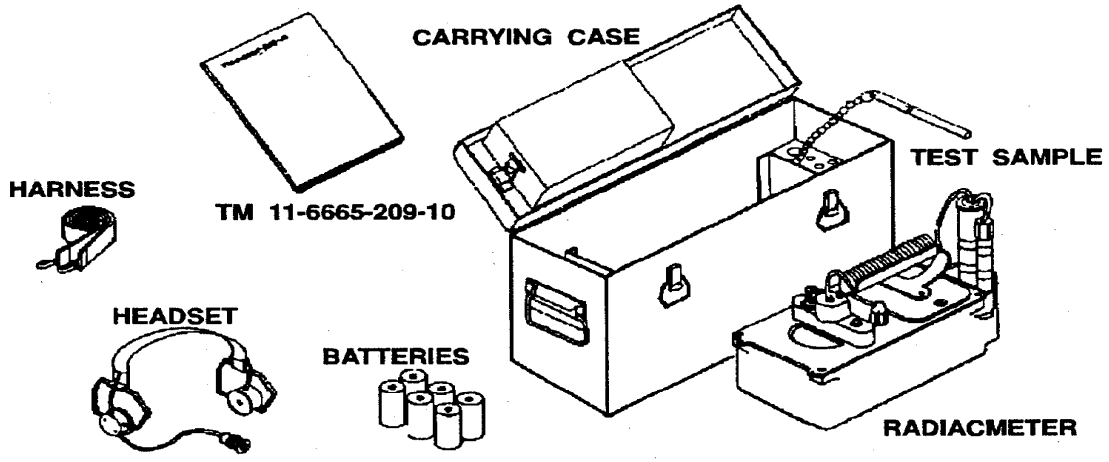

Figure 5-15. AN/PDR27 Radiac Set

5-4. **First-Aid Equipment**

a. Nerve agent poisoning requires immediate first-aid treatment. Soldiers receive three NAAKS, Mark I (Figure 5-16), for this purpose. Soldiers may become subjected to nerve agent poisoning on the battlefield. Immediate treatment with the NAAK is required if they are to survive. The NAAK consists of one small autoinjector containing atropine and a second autoinjector containing pralidoxime chloride. A plastic clip holds the two injectors together. Store the NAAK in the accessory storage pocket inside your mask carrier. Protect the NAAK from freezing.

b. The nerve agent pretreatment Pyridostigmine (NAPP) (Figure 5-17) is an adjunct to the NAAK (Figure 5-16). When used

in conjunction with the NAAK this pretreatment enhances the survivability of the soldier in a nerve agent chemical environment. Each soldier is initially issued one NAAK, which he is responsible for carrying and safeguarding against loss. He will secure the NAPP in the sleeve or breast pocket of the BDO. Soldiers will begin taking their NAPP tablets when ordered by their commander based on his assessment of possible agent exposure within the next few hours or days. One tablet is to be taken on a continuous basis once every eight hours until all 21 tablets have been taken or the soldier has been directed to discontinue taking the tablets. NAPPs should be stored/refrigerated in temperatures ranging from 35F to 46F. If the medication is removed from the refrigerator for a total of six months, it should be assumed that it has lost its potency and should not be used.

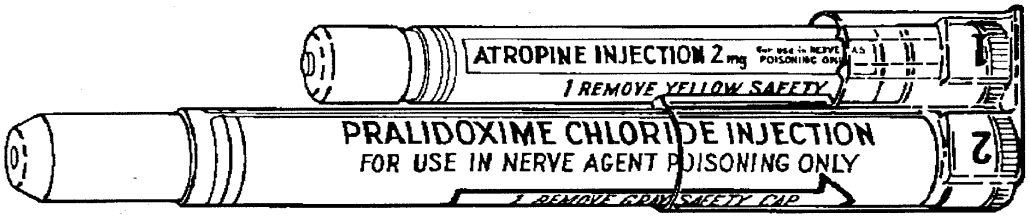

Figure 5-16. Mark I Kit

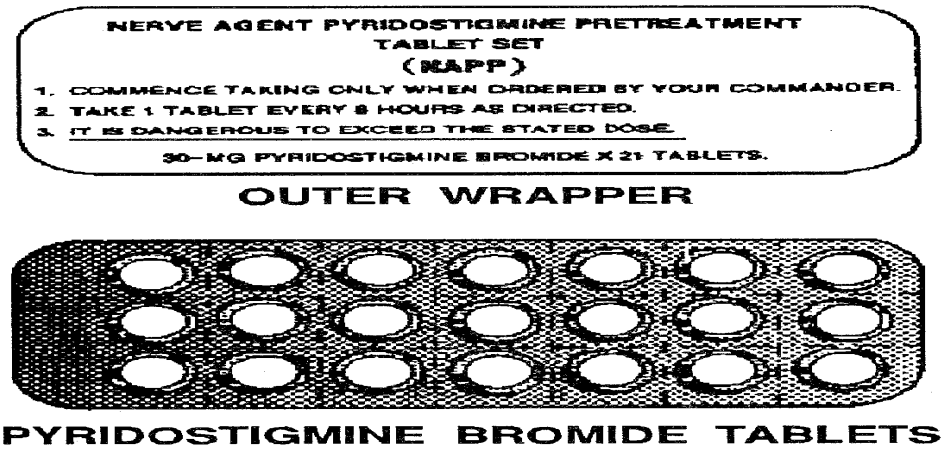

Figure 5-17. Pyridostigmine Pretreatment Tablet

c. The CANA (Figure 5-18) is similar to existing autoinjectors but modified to hold a 2-milliliter volume of diazepam. The exterior of the autoinjector will be distinguishable from the NAAK kit by two flanges on the length of the barrel. The autoinjector is packaged in a chemically hardened material. The

CANA is a disposable device for intramuscular delivery of diazepam to a buddy who is incapacitated by nerve agent poisoning. It is administered by buddy aid only and is an adjunct to the NAAK kit. The CANA is an individually issued item. See TM 8-288 for further information.

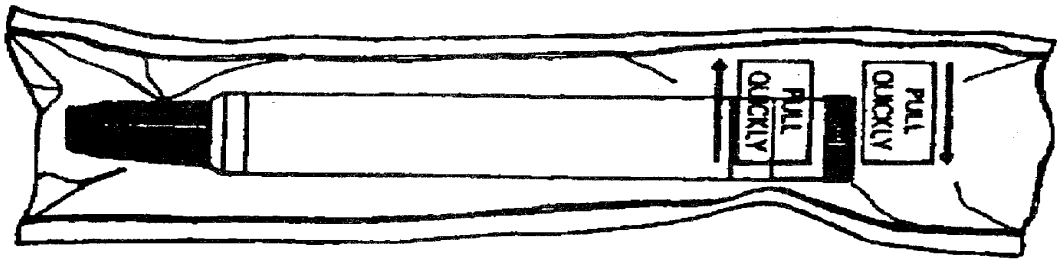

Figure 5-18. Convulsant Antidote for Nerve Agent

d. Related equipment. Commanders must ensure that the appropriate section, squad, or platoon has personnel trained to operate and maintain the assigned NBC defense equipment. Operation and maintenance of individual and unit NBC equipment are both a leadership and individual responsibility. Not everyone in the unit will be provided these items of NBC equipment, but any soldier may become responsible for them or need to use them. The items include the M256/M256AI chemical agent detector kit, IM93/UD dosimeter, Mll decontaminating apparatus, and M13 decontaminating apparatus. Skills applicable to these items can be found in STP 21-24.